



**High Capacity  
Optoelectronic  
Interconnects**

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# **Optoelectronic Devices for Multidimensional Interconnections**

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**with input from**

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**David A.B. Miller, Stanford Univ.**

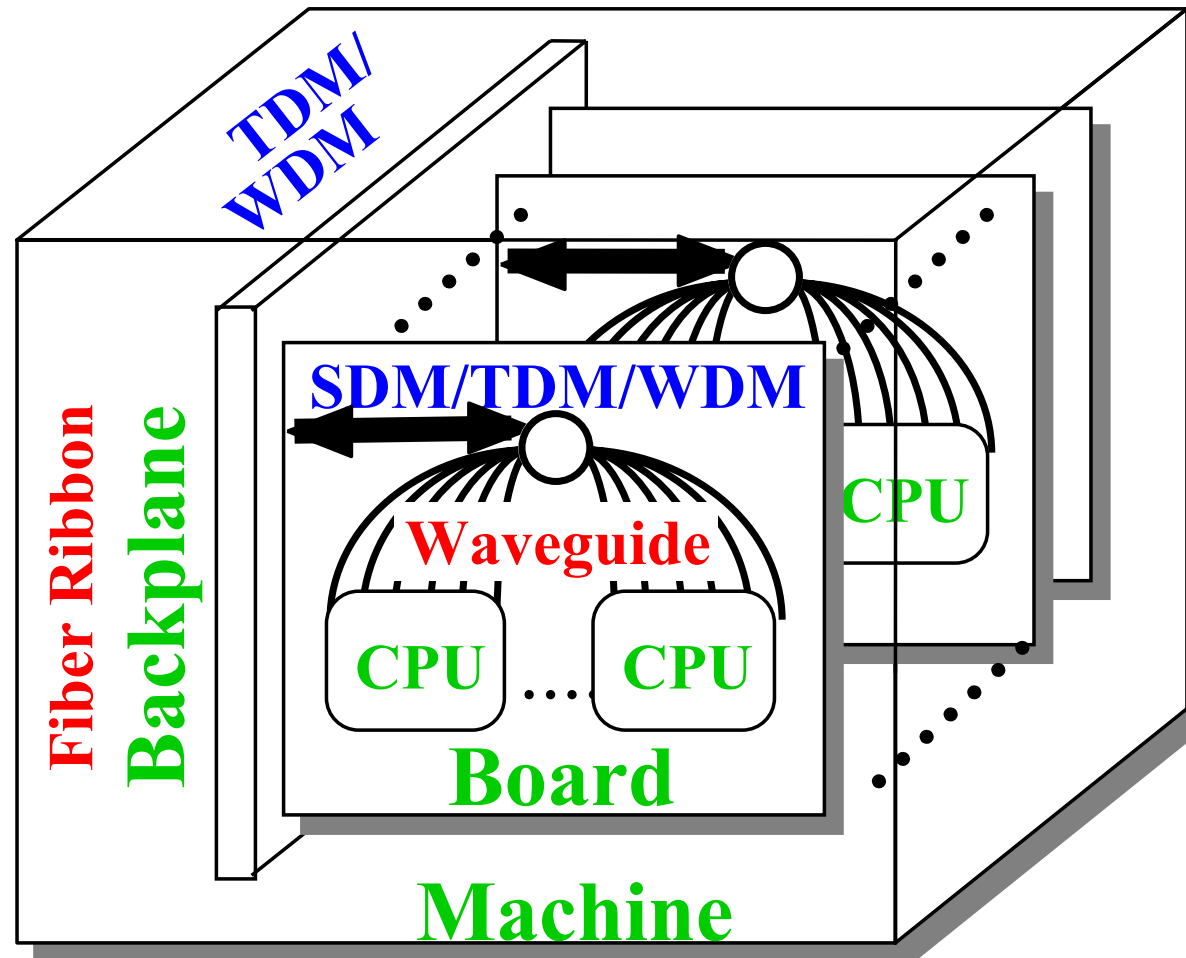


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# High-capacity optoelectronic interconnections



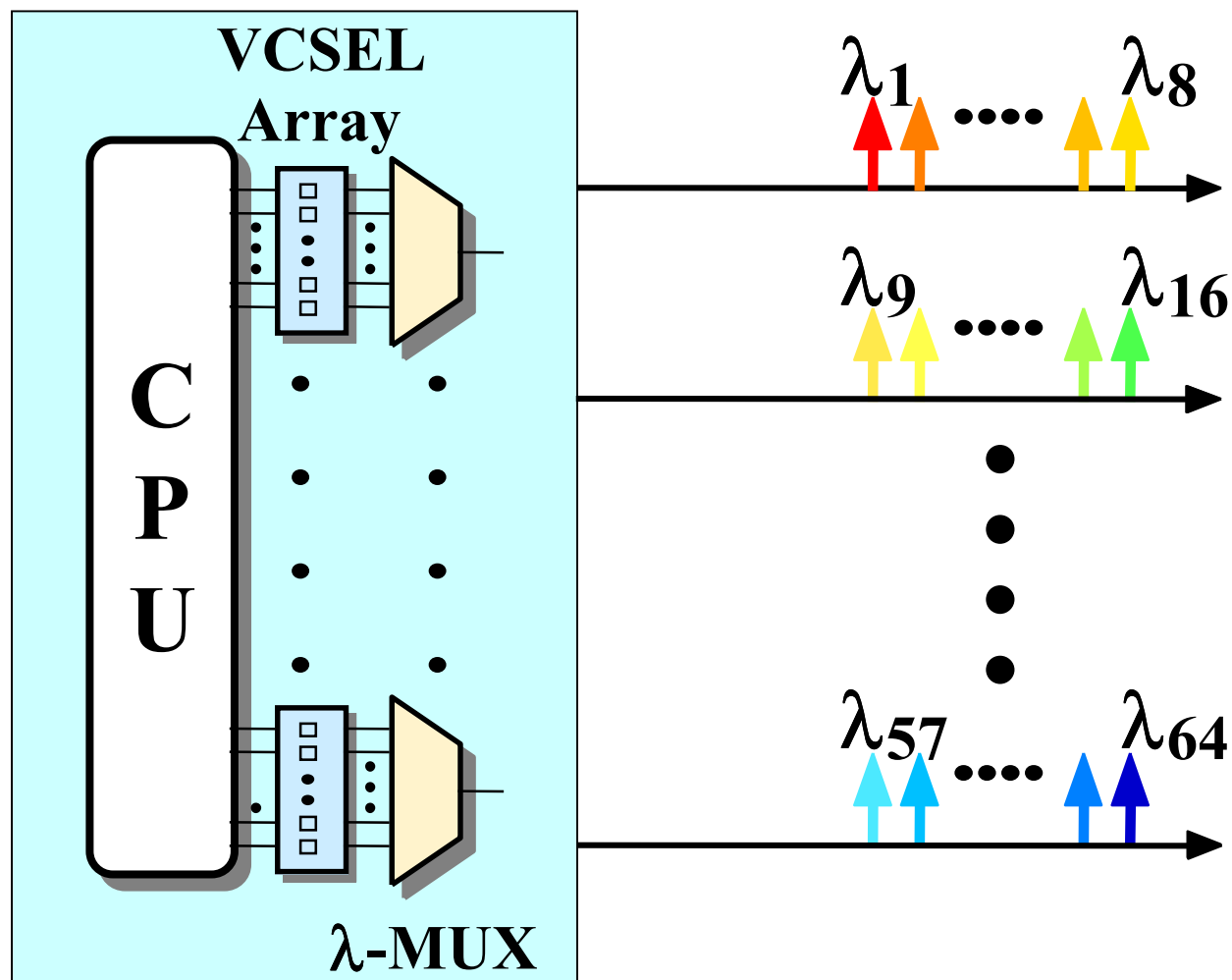
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# Basic optical interconnect

Transmit  
parallel  
bits between  
CPU's  
on sets of  
parallel  
wavelength



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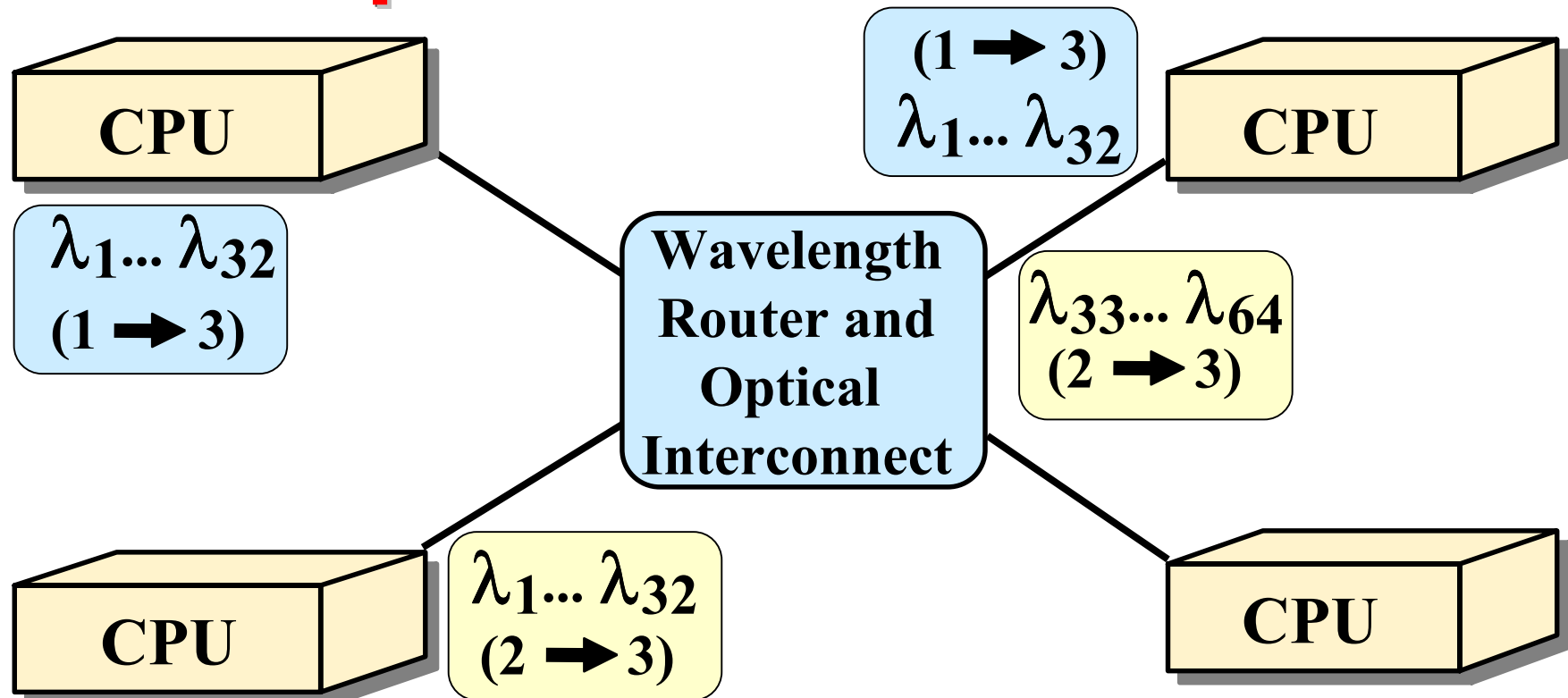


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# Optical interconnect



Shifting blocks of  $(\lambda_1 \dots \lambda_{32})$  to a new  $\lambda$ -regime  $(\lambda_{33} \dots \lambda_{64})$



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# Outline

- Time Slot Interchange and Wavelength Shifting
- Wavelength Shifting of Subcarrier Multiplexed Channels
- Chip Scale Optical Processing Components
- Latency in Optical Interconnections

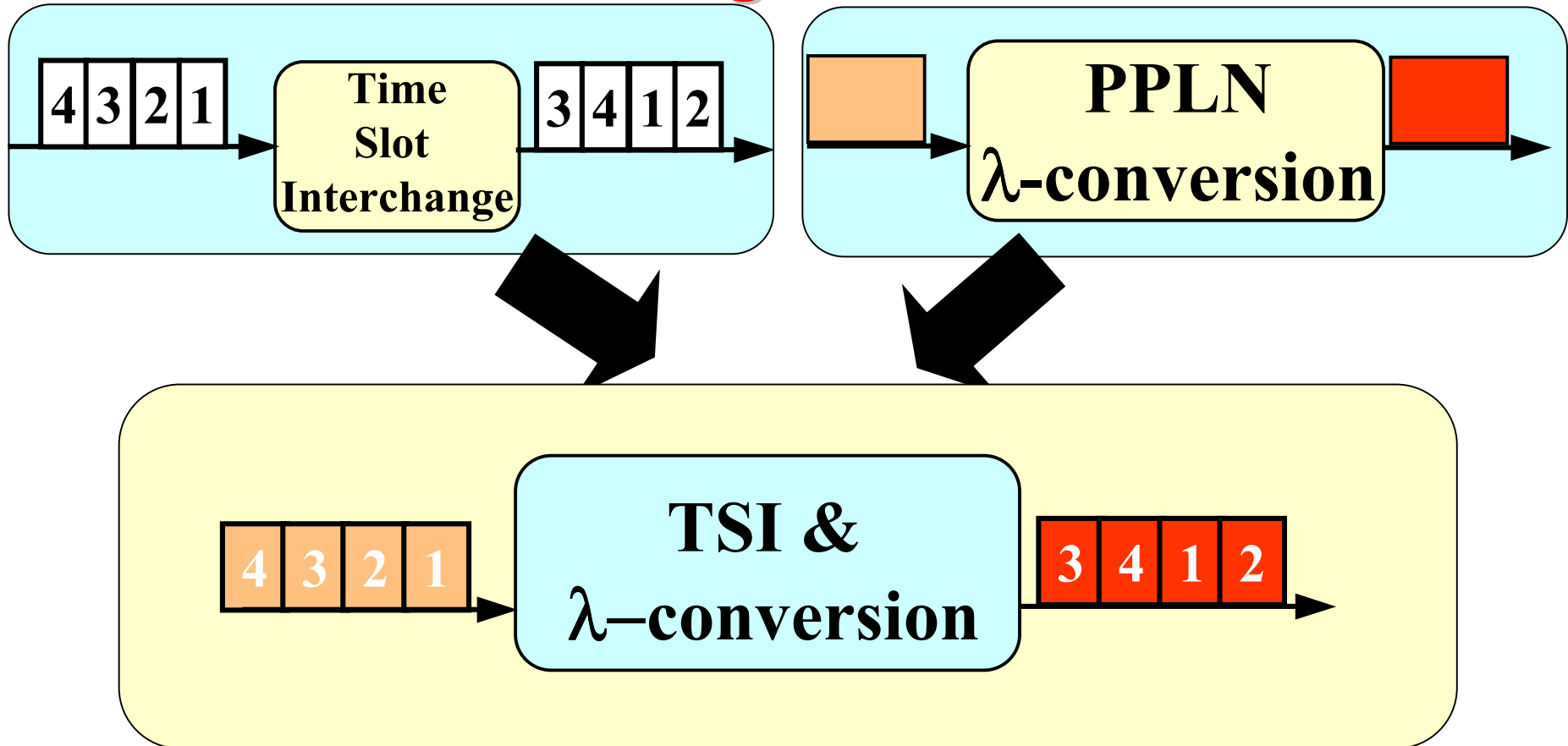


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# Multidimensional switching: Wavelength and time

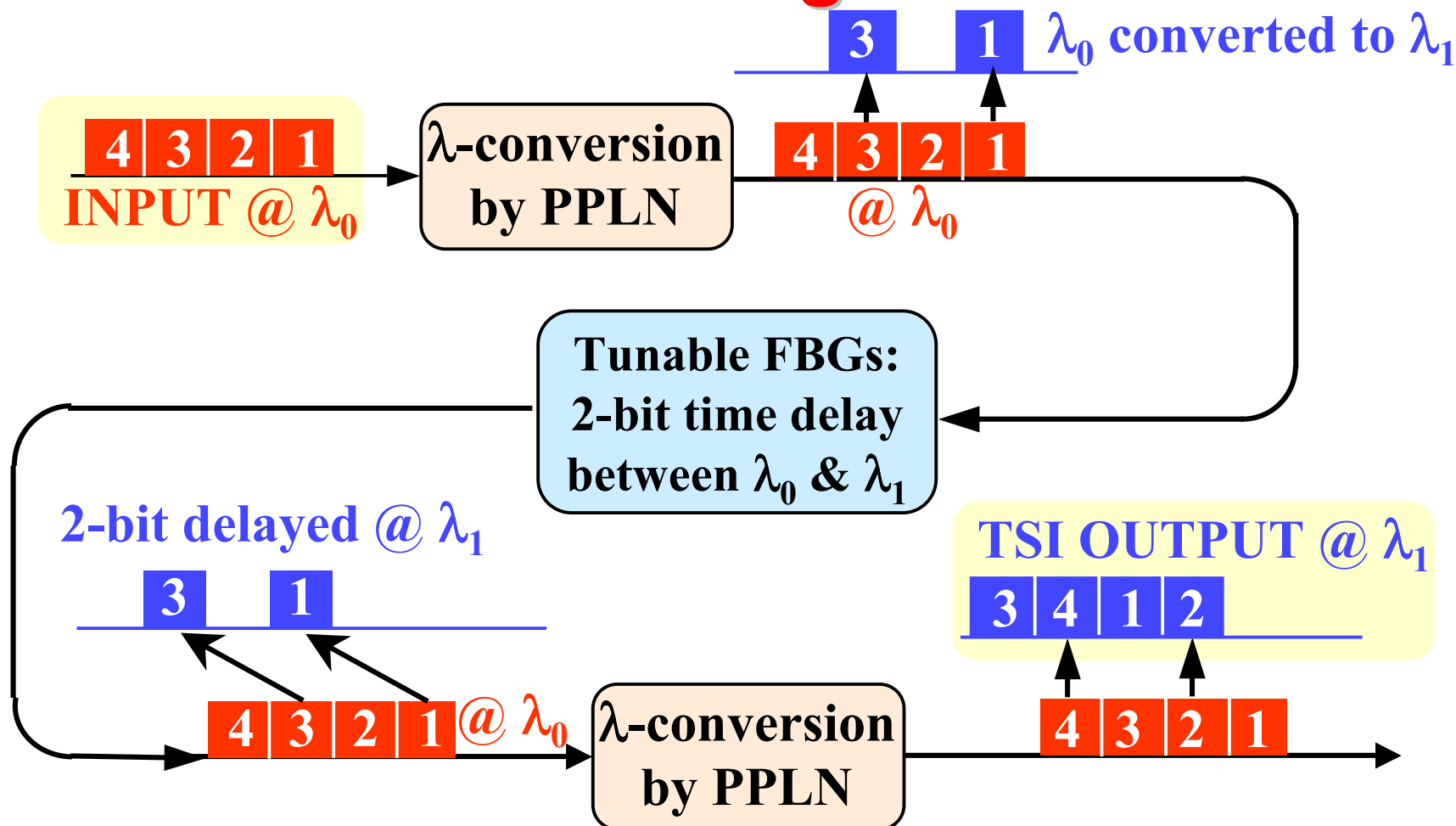


**Combine TSI and  $\lambda$ -conversion in a single interconnection**

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# TSI with wavelength conversion



- Odd numbered slots are mapped to  $\lambda_1$  at the 1st PPLN.
- At the 2nd PPLN, even numbered slots are  $\lambda$ -shifted.

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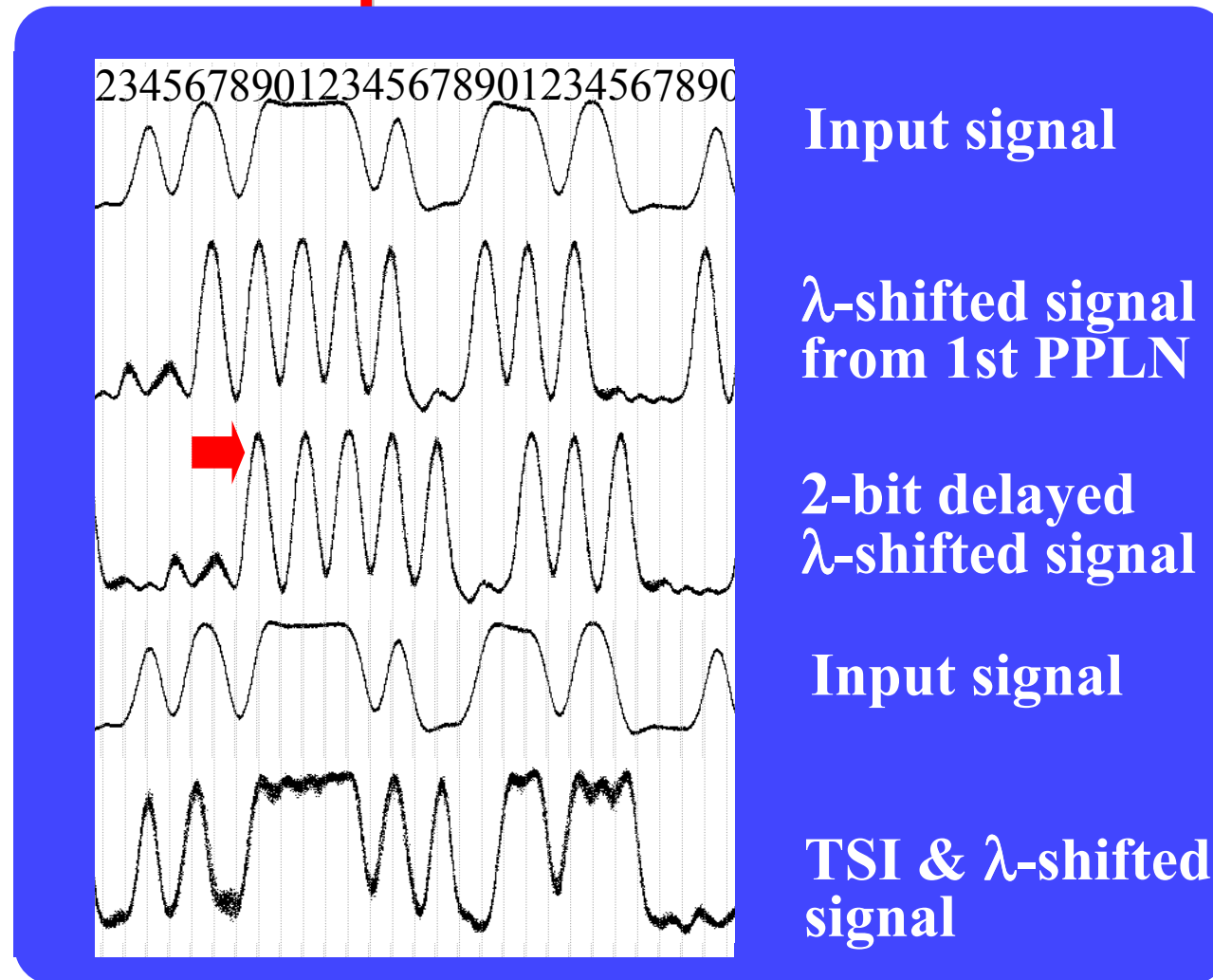


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## TSI experiment waveforms



**Time slot interchange defines the output destination.**

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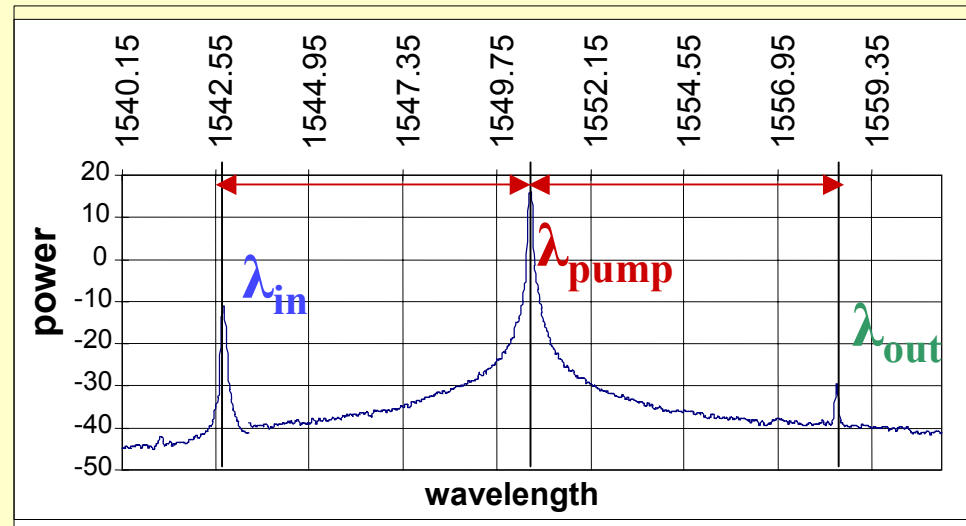




# Difference frequency generation by PPLN

- $\lambda_{\text{out}} = 2\lambda_{\text{pump}} - \lambda_{\text{in}}$   
Mirror image of  
the input  
wavelength is  
 $\lambda_{\text{out}}$ .
- DFG has a  
bandwidth of  $\sim$   
40 nm.

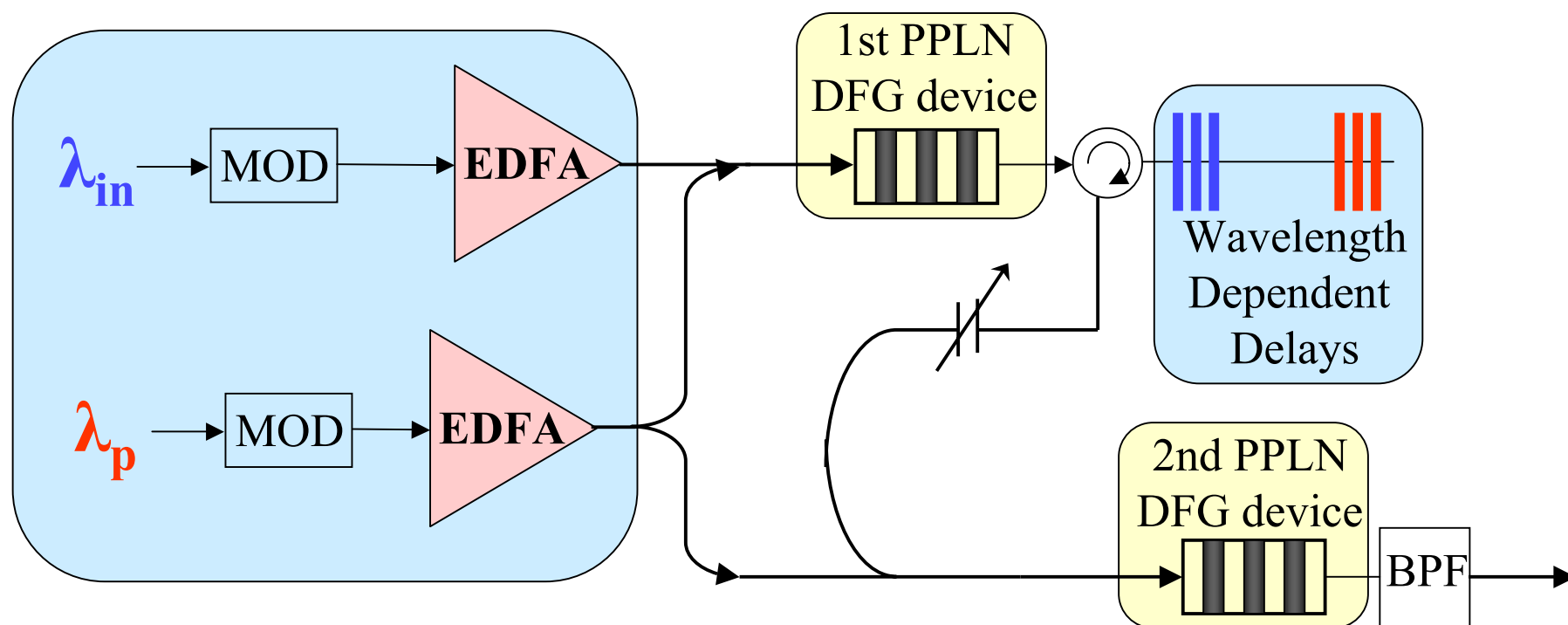
Spectrum of DFG by PPLN



Conversion efficiency  
theoretical limit is  $-4$  dB.



# TSI experiment with PPLN



- Input data is at 2.5 Gbps.
- Time slot interchanged data is at the output of 2<sup>nd</sup> PPLN.